National Renewable Energy Laboratory

U.S. DOE Natural Gas/Renewable Energy Hybrids Workshop

Breakout Session

Group #3

Utility or Societal Value Summary Results

At

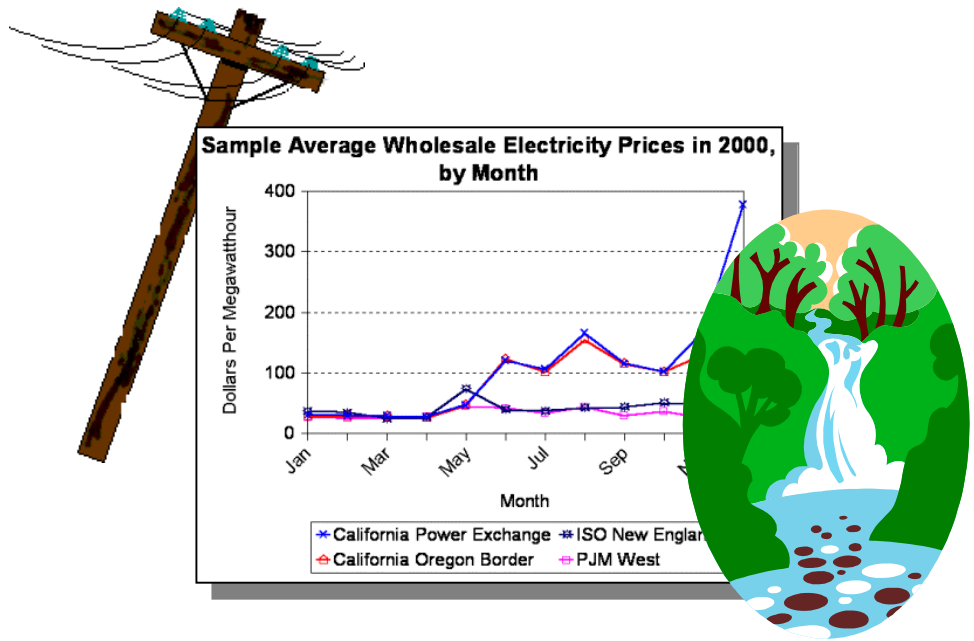
The National Renewable Energy Laboratory

Golden, CO

August 21-22, 2001

Breakout Session
Group #3
Utility or Societal Value

- **Electric Distribution Grid Support**
- **Power Price Stabilization**
- **Green Power**



Electric Distribution Grid Support Needs of Market Sector

- Dispatchability
- Defer or Obviate Asset Investment
- Capacity
- Rules of Engagement
- Command & Control Communications
- Operational and Interconnection Standards
- Clean Enough
- System Coordination
- Built-in Environmental Compliance
- Cost Effective
- Reliable Natural Gas Infrastructure

Electric Distribution Grid Support Needs of Market Sector (cont'd)

- Asset Planning for Future Expansion
- Incentives to Use DER
- Ancillary Services
- Proven Technologies (Testing, Certification, etc.)
- Peak Shaving, Relieve Congestion, Valley Filling
- Safe and Stable Islanding
- Sensors & Meters
- Ability to Unbundle Grid Functionality or Disaggregate by Geography and Function
- Ancillary Services for Some DER
- Summary: Grid Operator's Four Top Concerns:
  - Safety
  - Reliability
  - Cost-Effective Functionality
  - Environmental Compliance or Acceptability

Electric Distribution Grid Support Hybrid Configurations

- Valuable Hybrids Attributes:
  - Predictable in performance, e.g., dispatchability
  - Contain power electronic, command & control, and communication systems
  - Environmentally clean enough
  - Offer portability for short term needs
- Current examples:
  - Cogen w/cooling
  - Renewables w/storage or fossil generation and renewables
  - Relatively large units because of high transaction costs
  - Hybrids with static power conditioning

Electric Distribution Grid Support Hybrid Configurations (cont'd)

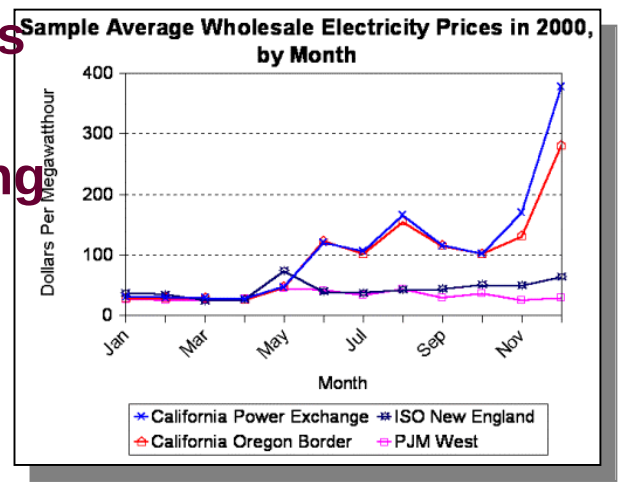
- **Future examples:**
  - **Fuel cell and turbine**
  - **Electrolyzer and fuel cell**
  - **Almost any prime mover with multiple-response storage, e.g., ultracapacitor, flywheel, battery**
  - **Smaller hybrid unit size because transaction costs down**
  - **And so on**

Electric Distribution Grid Support R&D Needs

- Improve hybrid systems to provide more and more functions to the electric grid
- Field tests
- Systems integration design and operation tools
- Technology performance characterizations
- Command & control and communications hardware, sensors, algorithms, models, etc.
- Barriers removal – policy, regulatory, industry culture, business transaction rules of engagement
- Must finish job of interconnection standards

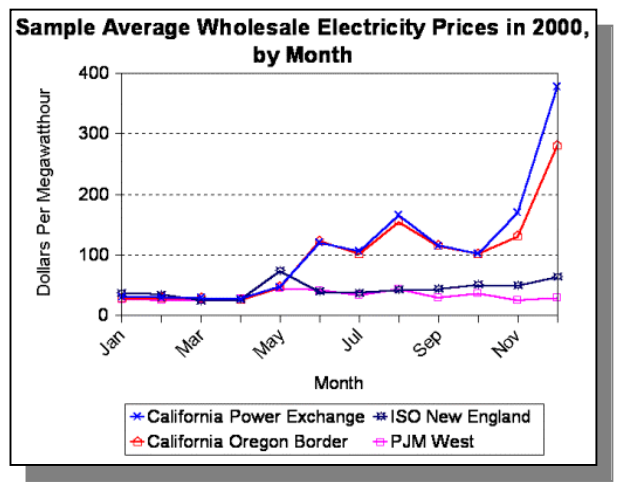
Power Price Stabilization Needs of Market Sector

- Generation and T&D Capacity
- Better Price Signals, e.g., real time, and Price Visibility
- Customer-Friendly
- Fuel or Energy Source Diversity, or Storage
- Real-Time Control and Optimization of Dispatch
- Hedging or Gaming Analyses an Processes
- High Ramp Rates for Generation
- Good Load Control Systems Complimenting DER Hybrid
- Metering Compatible with New Business Propositions



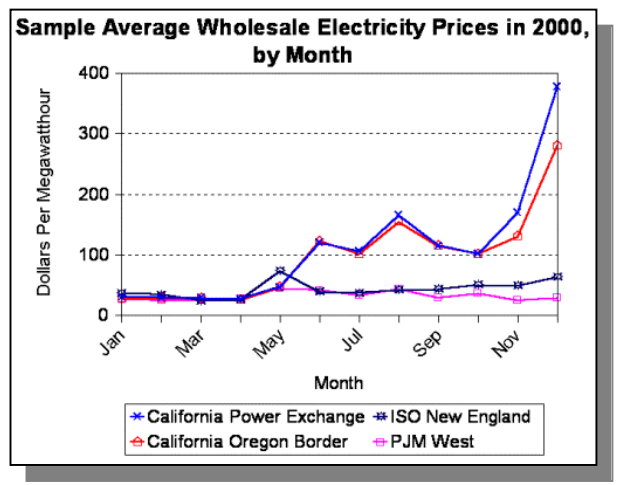
Power Price Stabilization Hybrid Configurations

- Fuel Diversity or No Fuel Costs, e.g., Renewables
- Energy Storage (large volume)
- Quick Ramp Rates
- Responsive Dispatch Tied to Price Signals
- Integrated with Load Management Systems



Power Price Stabilization R&D Needs

- Market, Hedging, etc., Analyses
- Command & Control Hardware and Software
- Improved Energy Storage – large volume, reliable, cheaper
- Hybrids that Can Ramp in under 15 Minutes
- Adequate Natural Gas Infrastructures
- Sensors, Meters, Models, Communications for Real Time Price Signals, Auditing, and Other Market Transactions
- Lower Cost Renewables



Green Power
Needs of Market Sector

- **Summary**
  - **Know What Is "Green"**
  - **Don't Let the Perfect Be the Enemy of Good**
  - **Understand Climate Change Issues and Facts**
  - **DER that Doesn't Contribute to CO_2**
- **Knowledge of Your Market, e.g., Competitive, RFP**
- **Standards on What Is "Green" – Clean air? Water? Land?**
- **Better Understanding of Net Environmental Benefits, and Regulation, e.g., RPS, that Recognizes**
- **Internalize 'Green" Attributes**
- **Better Access to Renewables and H_2 Systems**
- **Carbon Trading**

Green Power
Hybrid Configurations

- **Current:**
  - **PV or Wind with Storage or Recip**
  - **Co-Firing Coal with Biomass**
  - **Landfill Gas Augment with Natural or Bio- Gas, Solar Generation**
  - **Cogen**
- **Uses Renewables or Low Emission Generation, e.g., Nuclear, Especially with Storage to Avoid Part Load Operation or "Fuel" Dumping**
- **H_2 Fueled If From Renewable or Nuclear**
- **Biomass and Fossil Co-Firing**
- **Solar Generation and Absorption Cooling**
- **Cogen**

Green Power R&D Needs

- Low-Cost, High-Turnaround Storage
- Low-Cost Renewable and H_2 Systems
- Better, Standard Definition of "Green" and Understanding of "Net Environmental" Benefits
- More Flexible and Complex RPS to Permit Hybrids
- Hybrids that Are "Dialable" to Meet Different "Green" Requirements
- Studies on "Green" Pricing, Green Power Successes, etc.
- Roles and Contributions of Green Hybrids to Global Climate Change Control
- Field Tests of Green Hybrids
- "Golden Carrot" Green Hybrid Technology Development and Deployment Approach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